

Pamela F. Faggert  
Vice President and Chief Environmental Officer  
5000 Dominion Boulevard, Glen Allen, VA 23060  
Phone: 804-273-3467



August 21, 2006

Mr. Michael F. Kiss  
Meteorologist, Office of Data Analysis  
Virginia Department of Environmental Quality  
629 East Main Street  
P.O. Box 10009  
Richmond, Virginia 23240

Subject: Exemption Modeling Under Best Available Retrofit Technology (BART) Requirements  
Dominion Chesterfield Units 5 and 6

Dear Mr. Kiss:

Please find enclosed a copy of a report which details the BART exemption modeling analysis that was performed for Dominion's Chesterfield Power Station Units 5 and 6.

As you know this unit was identified as being BART-eligible. Sources in this category have been afforded the option of performing dispersion modeling to demonstrate that the source cannot reasonably be anticipated to cause or contribute to visibility impairment in a Class I area. If this demonstration can be made successfully, then the source is exempt from further requirements under the BART program.

A modeling analysis of this type was performed for Units 5 and 6 at Chesterfield Power Station according to procedures outlined in our April 13, 2006 letter and according to the updated VISTAS protocol (dated December 22, 2005, revision 3 – July 18, 2006). This analysis focused on the impact of PM10 since the Virginia Department of Environmental Quality has determined, consistent with USEPA policy, that requirements for electric generating units under the Clean Air Interstate Rule will satisfy BART requirements for emissions of SO<sub>2</sub> and NO<sub>x</sub> from eligible units.

The results of the analysis demonstrate that PM10 emissions from Chesterfield Units 5 and 6 do not cause or contribute to visibility impairment in any Class I area. It is our understanding, therefore, that these units are exempt from further analysis under the BART rule.

We request your review and approval of the analysis documented in the attached report. Electronic files used to execute the Calpuff model as part of the analysis are enclosed on CD. Please contact Jim Browder if you have any questions at (804) 273-3019 or at James\_Browder@dom.com.

Very truly yours,

A handwritten signature in black ink that reads "Pamela F. Faggert".

Pamela F. Faggert

Enclosure

cc: Ms. Tamera Thompson, Director, Office of Air Permit Programs, DEQ (w/o CD)  
Mr. James Kyle, Air Permit Manager, Piedmont Regional Office, DEQ (w/o CD)

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# *BART Exemption Modeling Report*

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## **Chesterfield Power Station**

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*August 21, 2006*

Prepared by:



**Aegis Environmental, Inc.**  
211 Ruthers Road  
Suite 202  
Richmond, VA 23235

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## **1. INTRODUCTION**

Dominion's Chesterfield Power Station in Chesterfield County, Virginia has been identified as an eligible source under the Best Available Retrofit Technology (BART) program. In order to be exempt from the control technology analysis required under BART, the facility must demonstrate through air dispersion modeling that the facility is not causing or contributing to the visibility degradation in Class I Areas. USEPA has provided guidance that Clean Air Interstate Rule (CAIR) requirements will satisfy BART for SO<sub>2</sub> and NO<sub>x</sub> for electric generating units. For this reason, this BART exemption modeling summarized in this report addresses only PM10 impacts on visibility.

The results of the fine grid Calpuff modeling indicate that Chesterfield Power Station is exempt from BART requirements. All 24-hour maximums are below the 0.5 dv BART exemption threshold, as discussed further in the "Results" section of this document.

## **2. SOURCE DESCRIPTION AND EMISSIONS**

The Class I areas within the modeling domain (within 300 km of Chesterfield Power Station) are Brigantine, Dolly Sods, James River Face Wilderness, Otter Creek, Shenandoah National Park, and Swanquarter. These Class I areas are shown in Appendix 1.

The BART eligible sources at Chesterfield Power Station are two coal-burning units, Unit 5 and Unit 6. Both units have electrostatic precipitators (ESPs) for PM10 control and selective catalytic NO<sub>x</sub> reduction. Wet flue gas desulfurization systems are required to be installed on these units according to a consent decree between USEPA, Virginia DEQ and other parties. Emissions from these two units have been calculated using workbooks provided by Federal Land Managers (FLM) and stack test results for PM10 fractions of TSP as "filterable PM10" input into the calculations. These workbooks speciate the PM10 into Coarse, Fine Soil, Fine Elemental Carbon, and Soil Organics, which are then used as input into the Calpuff model. The PM10 speciation workbooks and geometric mass mean diameter calculations based on the same FLM workbooks cited above are located in Appendices 2 and 3 respectively.

### **3. MODELING PROCEDURES**

The BART exemption modeling has been conducted using region five 4-km CALMET meteorological databases provided by VISTAS. VISTAS has developed five sub-regional 4-km CALMET meteorological databases for three years (2001-2003). Databases for the years 2001-2003 were used as CALMET inputs for this modeling. The computational grid, a subset of the meteorological grid described above, was created to include Chesterfield Power Station, and all the Class I areas within 300 km of the power station.

Receptors for the Class I areas within the computational grid were obtained from the National Park Service, through the VISTAS website. For this modeling analysis, there were a total of 605 receptors, with receptors 1-65 corresponding to Dolly Sods, receptors 66-117 corresponding to James River Face Wilderness, receptors 118-239 corresponding to Otter Creek, receptors 240-537 corresponding to Shenandoah National Park, receptors 538-589 corresponding to Swanquarter and receptors 590-605 corresponding to Brigantine.

The hourly ozone dataset was generated from non-urban monitors within the computational grid as provided by VISTAS (available at: [http://www.src.com/verio/download/sample\\_files.htm](http://www.src.com/verio/download/sample_files.htm)). The Calpuff default value of 80 ppb was used for the background ozone concentration when all hourly data was missing for each station. In accordance with VISTAS recommendations, a constant background value of 0.5 ppb for ammonia was input into the Calpuff file.

Natural background light extinctions, and monthly f(RH) values for each Class I area were required as part of the Visibility processing inputs. Natural background light extinctions were calculated using the annual averages provided in Appendix B of EPA's "Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule", and the equations

$$b_{back} = 10 e^{(HI/10)}$$

$$b_{back} = b_{ray} + b_{soil}$$

where  $b_{ray} = 10 \text{ Mm}^{-1}$  (Rayleigh Scattering) and  $b_{soil}$  represents the background due to Soil (because the extinction coefficient of Soil is 1.0, the monthly background due to Soil is the same as the extinction for all particulates in the background,  $b_{soil}$ ). Monthly site-specific f(RH) values based on

the centroid of the area were obtained from Table A-3 of EPA's "Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule".

#### **4. MODELING OPTIONS**

The Chesterfield Power Station BART exemption modeling has been conducted following the guidance of the VISTAS common BART modeling protocol ([http://www.vistas-sesarm.org/BART/BARTModelingProtocol\\_rev3\\_18Jul2006.pdf](http://www.vistas-sesarm.org/BART/BARTModelingProtocol_rev3_18Jul2006.pdf)), and is consistent with the modeling procedures outlined in the modeling protocol submitted April 13, 2006. The VISTAS common BART modeling protocol recommends use of the IWAQM (EPA, 1998) guidance for all Calpuff modeling options. The common protocol also states that building downwash effects need not be used, unless the state so directs the source to include the effects. For this exemption modeling, the IWAQM guidance was followed and building downwash effects were not modeled.

Postutil was used to rename modeling particulate species to correspond with the Calpost species library, but no other computational changes were made to the concentration files using Postutil.

Visibility was processed using the Calpost processor, Method 6, as outlined in the VISTAS common protocol.

Input files for Calpuff, Postutil and Calpost, and all the output files from those runs are included on the Modeling CD.

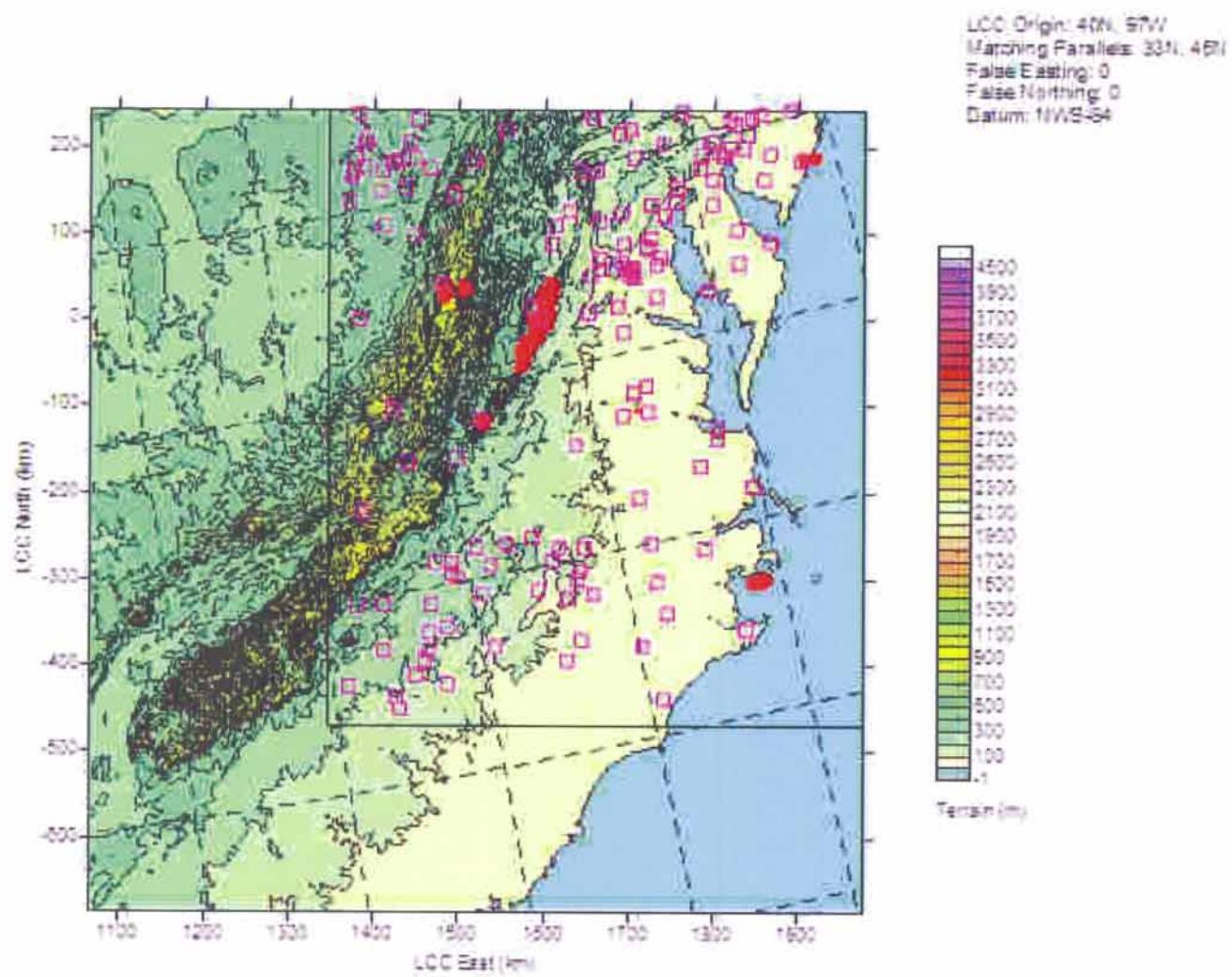
#### **5. RESULTS**

The visibility analysis showed that all Class I areas had less than the 0.5 dv "threshold" change in light extinction. Results for each Class I area are shown in the table below:

Days below the 98th percentile of days in each year of the three-year modeling period, as appropriate.

Class I Area	# days with impact > 0.5 dv in 2001	# receptors	# days with impact > 0.5 dv in 2002	# receptors	# days with impact > 0.5 dv in 2003	# receptors	# days with impact > 0.5 dv in 3-yr period	# receptors	# days with impact > 1.0 dv in 3-yr period	# receptors	Max 24-hr impact over 3-yr period (dv)
Brigantine	0	0	0	0	0	0	0	0	0	0	0.044
Dolly Sods	0	0	0	0	0	0	0	0	0	0	0.015
James River Face	0	0	0	0	0	0	0	0	0	0	0.046
Otter Creek	0	0	0	0	0	0	0	0	0	0	0.013
Shenandoah NP	0	0	0	0	0	0	0	0	0	0	0.082
Swanquarter	0	0	0	0	0	0	0	0	0	0	0.035

## *Appendix I*



## *Appendix 2*

Chesterfield #5  
Controlled PM10 Speciation from AP-42 Tables 1.1-5 & 1.1-6  
Dry Bottom Boiler burning Pulverized Coal using FGD + ESP for Emissions control

assumes heating value of **12620** Btu/lb and a sulfur content of **1.15** % and an ash content of **10.32** % and a heat input of **3.275** mmBtu/hr and f(RH) = **1**

Controlled PM10 Emissions (Bold values from Table 1.1-5.)							
Boiler Type	Total PM10 (lb/mmBtu)	Filterable (lb/mmBtu)	Coarse (lb/mmBtu)	Fine (lb/mmBtu)	Fine Soil Ext. Coef. (lb/mmBtu)	Fine EC Ext. Coef. (lb/mmBtu)	Condensable (lb/mmBtu)
PC-DB	0.0421	0.0221	0.0123	0.6	0.0098	0.0094	0.020

Controlled PM10 Emissions (Bold values from Table 1.1-6.)							
Boiler Type	Total PM10 (lb/ton)	Filterable (lb/ton)	Coarse (lb/ton)	Fine (lb/ton)	Fine Soil Ext. Coef. (lb/ton)	Fine EC Ext. Coef. (lb/ton)	Condensable (lb/ton)
PC-DB	1.062	0.557	0.310	0.6	0.248	0.239	0.565

Controlled PM10 Emissions (Bold Values from Table 1.1-6.)							
Boiler Type	Total PM10 (lb/ton)	Filterable (lb/ton)	Coarse (lb/ton)	Fine (lb/ton)	Fine Soil Ext. Coef. (lb/ton)	Fine EC Ext. Coef. (lb/ton)	Condensable (lb/ton)
PC-DB	100%	52.5%	29.2%	0.6	23.3%	22.5%	1

If you are given Total PM10 emissions in lb/ton:

Controlled PM10 Emissions (Bold Value is Input by user.)							
Boiler Type	Total PM10 (lb/mmBtu)	Filterable (lb/mmBtu)	Coarse (lb/mmBtu)	Fine (lb/mmBtu)	Fine Soil Ext. Coef. (lb/mmBtu)	Fine EC Ext. Coef. (lb/mmBtu)	Condensable (lb/mmBtu)
PC-DB	0.042	0.022	0.0123	0.6	0.0098	0.0094	0.020

If you are given Total PM10 emissions in lb/mmBtu:

Controlled PM10 Emissions (Bold Value is Input by user.)							
Boiler Type	Total PM10 (lb/ton)	Filterable (lb/ton)	Coarse (lb/ton)	Fine (lb/ton)	Fine Soil Ext. Coef. (lb/ton)	Fine EC Ext. Coef. (lb/ton)	Condensable (lb/ton)
PC-DB	100%	52.5%	29.8	16.6	0.6	13.2	12.8

If you are given Filterable PM10 emissions in lb/ton:

Controlled PM10 Emissions (Bold Value is Input by user.)							
Boiler Type	Total PM10 (lb/mmBtu)	Filterable (lb/mmBtu)	Coarse (lb/mmBtu)	Fine (lb/mmBtu)	Fine Soil Ext. Coef. (lb/mmBtu)	Fine EC Ext. Coef. (lb/mmBtu)	Condensable (lb/mmBtu)
PC-DB	100%	52.5%	29.8	16.6	0.6	13.2	12.8

If you are given Filterable PM10 emissions in lb/mmBtu:

Controlled PM10 Emissions (Bold Value is Input by user.)							
Boiler Type	Total PM10 (lb/ton)	Filterable (lb/ton)	Coarse (lb/ton)	Fine (lb/ton)	Fine Soil Ext. Coef. (lb/ton)	Fine EC Ext. Coef. (lb/ton)	Condensable (lb/ton)
PC-DB	100%	56.8	0.022	0.6	0.0123	0.0098	0.020

If you are given Total PM10 emissions in lb/ton:

Controlled PM10 Emissions (Bold Value is Input by user.)							
Boiler Type	Total PM10 (lb/mmBtu)	Filterable (lb/mmBtu)	Coarse (lb/mmBtu)	Fine (lb/mmBtu)	Fine Soil Ext. Coef. (lb/mmBtu)	Fine EC Ext. Coef. (lb/mmBtu)	Condensable (lb/mmBtu)
PC-DB	0.042	0.022	0.0123	0.6	0.0098	0.0094	0.020

Coarse  
Fine Soil  
22.5%  
0.9%  
38.0%  
CPM IOR  
9.5%  
100.0%

Fine EC  
CPM IOR  
CPM OR  
5.4  
56.8

16.6  
12.8  
0.5  
21.6  
5.4  
56.8

Particle

Ext. Coef.

Condensable

Fine EC

Ext. Coef.

Condensable

Ext. Coef.

Chesterfield #6  
Controlled PM10 Speciation from AP-42 Tables 1.1-5 & 1.1-6  
Dry Bottom Boiler burning Pulverized Coal using FGD + ESP for Emissions control

assumes heating value of **12631** Btu/lb and a sulfur content of **1.16** % and an ash content of **9.18** % and a heat input of **6,372** mmBtu/hr and f(RH) = **1**

Controlled PM10 Emissions (Bold values from Table 1.1-5.)							
Boiler	Total PM10 (lb/mmBtu)	Filterable (lb/mmBtu)	Coarse (lb/mmBtu)	Fine (lb/mmBtu)	Fine Soil (lb/mmBtu)	Ext. Coef.	Fine EC (lb/mmBtu)
Type PC-DB	0.0396	0.0196	0.0109	0.6	0.0087	0.0084	0.0003

Controlled PM10 Emissions (Bold Values from Table 1.1-6.)							
Boiler	Total PM10 (lb/ton)	Filterable (lb/ton)	Coarse (lb/ton)	Fine (lb/ton)	Fine Soil (lb/ton)	Ext. Coef.	Fine EC (lb/ton)
Type PC-DB	1.002	0.496	0.276	0.6	0.221	0.212	0.008

Controlled PM10 Emissions (Bold Values from Table 1.1-6.)							
Boiler	Total PM10 (% of Total)	Filterable (% of Total)	Coarse (% of Total)	Fine (% of Total)	Fine Soil (% of Total)	Ext. Coef.	Fine EC (% of Total)
Type PC-DB	100%	49.5%	27.5%	0.6	22.0%	1	0.8%

If you are given Total PM10 emissions in lb/hr:

Controlled PM10 Emissions (Bold Value is Input by user.)							
Boiler	Total PM10 (lb/hr)	Filterable (lb/hr)	Coarse (lb/mmBtu)	Fine (lb/hr)	Fine Soil (lb/mmBtu)	Ext. Coef.	Fine EC (lb/mmBtu)
Type PC-DB	842.6	417.2	231.8	0.6	185.4	178.6	1

If you are given Total PM10 emissions in lb/mmBtu:

Controlled PM10 Emissions (Bold Value is Input by user.)							
Boiler	Total PM10 (lb/mmBtu)	Filterable (lb/mmBtu)	Coarse (lb/mmBtu)	Fine (lb/mmBtu)	Fine Soil (lb/mmBtu)	Ext. Coef.	Fine EC (lb/mmBtu)
Type PC-DB	0.040	0.020	0.0109	0.6	0.0087	0.0084	1

Controlled PM10 Emissions (Bold Value is Input by user.)							
Boiler	Total PM10 (% of Total)	Filterable (% of Total)	Coarse (% of Filterable)	Fine (% of Filterable)	Fine Soil (% of Filterable)	Ext. Coef.	Fine EC (% of Total)
Type PC-DB	100%	49.5%	55.6%	0.6	44.4%	1	1.6%

If you are given Filterable PM10 emissions in lb/mmBtu:

Controlled PM10 Emissions (Bold Value is Input by user.)							
Boiler	Total PM10 (lb/mmBtu)	Filterable (lb/mmBtu)	Coarse (lb/mmBtu)	Fine (lb/mmBtu)	Fine Soil (lb/mmBtu)	Ext. Coef.	Fine EC (lb/mmBtu)
Type PC-DB	842.6	417.2	231.8	0.6	185.4	178.6	1

Controlled PM10 Emissions (Bold Value is Input by user.)							
Boiler	Total PM10 (lb/hr)	Filterable (lb/hr)	Coarse (lb/mmBtu)	Fine (lb/mmBtu)	Fine Soil (lb/mmBtu)	Ext. Coef.	Fine EC (lb/mmBtu)
Type PC-DB	0.040	0.020	0.0109	0.6	0.0087	0.0084	1

Controlled PM10 Emissions (Bold Value is Input by user.)							
Boiler	Total PM10 (% of Total)	Filterable (% of Total)	Coarse (% of Filterable)	Fine (% of Filterable)	Fine Soil (% of Filterable)	Ext. Coef.	Fine EC (% of Total)
Type PC-DB	100%	49.5%	55.6%	0.6	44.4%	1	1.6%

If you are given Total PM10 emissions in lb/mmBtu:

Controlled PM10 Emissions (Bold Value is Input by user.)							
Boiler	Total PM10 (lb/mmBtu)	Filterable (lb/mmBtu)	Coarse (lb/mmBtu)	Fine (lb/mmBtu)	Fine Soil (lb/mmBtu)	Ext. Coef.	Fine EC (lb/mmBtu)
Type PC-DB	0.040	0.020	0.0109	0.6	0.0087	0.0084	1

Controlled PM10 Emissions (Bold Value is Input by user.)							
Boiler	Total PM10 (% of Total)	Filterable (% of Total)	Coarse (% of Filterable)	Fine (% of Filterable)	Fine Soil (% of Filterable)	Ext. Coef.	Fine EC (% of Total)
Type PC-DB	100%	49.5%	55.6%	0.6	44.4%	1	1.6%

## *Appendix 3*

Emissions based on lb/hr emissions rates derived from stack test results.  
Specification based on FLM workbook, with Dry-Bottom PC with ESP and FGD.

Unit	PM10	PMF	PMC	PM800*	PM425*	PM187*	PM112*	PM081*	PM056*	Fine Soil	Fine EC	CPM IOR	CPM OR
U5	56.8	29.8	16.6	7.6	9.3	5.3	1.3	0.9	5.3	12.8	0.5	21.6	5.4
U6	842.6	417.2	231.8	105.9	130.8	74.7	18.7	12.5	74.7	178.6	6.9	340.3	85.1

\* Indicates species modeled

\* PM800 is PM 6-10  $\mu\text{m}$

\* PM425 is PM 2.5-6  $\mu\text{m}$

\* PM187 is PM 1.25-2.50  $\mu\text{m}$

\* PM112 is PM 1-1.25  $\mu\text{m}$

\* PM081 is PM 0.625-1  $\mu\text{m}$

\* PM056 is PM 0.5-0.625  $\mu\text{m}$

Conversion  
453.592375 g/lb

Unit	PM10	PMF	PMC	PM800*	PM425*	PM187*	PM112*	PM081*	PM056*	Fine Soil	Fine EC	CPM IOR	CPM OR
U5	7.15668	3.754737	2.0915665	0.9875839	1.1717803	0.667788775	0.16379725	0.113398	0.6677889	1.612773	0.062999	2.721554	0.680389
U6	106.1658	52.56632	29.20631	13.3431757	16.480523	9.41204789	2.35616039	1.574974	9.412042	22.50322	0.863385	42.87708	10.72242
Total	113.3225	56.32105	31.29787	14.3007596	17.6623033	10.07983056	2.51995764	1.688372	10.07983	24.11599	0.932384	45.59863	11.40281

g/s Emissions  
PM Species Geometric Mass Mean Diameter

PM10 5.93

Fine Soil 1.18

Elemental C 1.18

SOA\* 0.48

\* from Calpull Species Library

#### CONDENSABLE

fine filterable

	coarse filterable inorganic (g/s)	inorganic (of carbon) filterable (g/s)	elemental (condensable) H <sub>2</sub> SO <sub>4</sub> (g/s)	inorganic condensable (H <sub>2</sub> SO <sub>4</sub> ) (g/s)	Diameter (μm)
PM10	60.96	127.7112			
Base Elevation (m)	10.0584	10.0584			
Diameter (m)	5.1816	6.096			
Gas Exit Velocity (m/s)	21.6408	30.48			
Exit Temp (K)	402.59	402.04			
H <sub>2</sub> SO <sub>4</sub> (g/s)	2.267962	4.4099259			

#### SPECIATION PROFILE - used in Geometric Mass Mean Diameter Calculations:

##### FILTERABLE

	Diameter (μm)	filterable (g/s)	coarse filterable inorganic (g/s)	inorganic (of carbon) filterable (g/s)	elemental (condensable) H <sub>2</sub> SO <sub>4</sub> (g/s)	Diameter (μm)
coarse	PM800	6.00 - 10.0	25.4%	14.3008	0.3730	6.00 - 10.00
	PM425	2.50-6.00	31.3%	17.65	0.0932	2.50-6.00
	PM187	1.25-2.50	17.9%	10.08	2.4267	1.25-2.50
	PM112	1.00-1.25	4.5%	2.52	0.0625	1.00-1.25
fine	PM081	0.625-1.00	3.0%	1.69	1.6259	0.625-1.00
	PM056	0.50-0.625	17.9%	10.08	9.7069	0.50-0.625
		1.0	pmc	31.9531	ec	
			(see D20)	23.4664	0.9016	
			(see K20)	50.3236	soil	
				25.1618	50.3236	(see M20) (see N20)